Basics of Mathematica

Basic Input

```
2 + 2
```

```
4
```

Symbols

Formulas

Help

Syntax

```
x + y
```

```
x + y
```

```
In[10]
```

```
x + y
```

```
%
```

```
x + y
```

= vs :=

Substitutions

Apply, Map

Distribute

Patterns

```
?? Collect
```

Collect[*expr*, *x*] collects together terms involving the same powers of objects matching *x*.
Collect[*expr*, {x_1, x_2, …}] collects together terms that involve the same powers of objects matching x_1, x_2, ….
Collect[*expr*, *var*, *h*] applies *h* to the expression that forms the coefficient of each term obtained. ≫

```
Attributes[Collect] = {Protected}
```

```
Options[Collect] = {Modulus → 0, Trig → False}
```

```
ClearAll[f]
```

```
f[2, 3] + f[2] /. f[a_] → 0
f[2, 3] + f[2] /. f[a__] → 0
```

```
f[2, 3]
```

```
0
```

```
{{M, a, {p, {}, {{l}, e}}}, s, {y, {r}}, u, p} //. {a___, {b___}, c___} → {a, b, c}
```

```
{M, a, p, l, e, s, y, r, u, p}
```

```
Flatten[{{M, a, {p, {}, {{l}, e}}}, s, {y, {r}}, u, p}]
```

```
{M, a, p, l, e, s, y, r, u, p}
```

Recursion

```
RSolve[{k/(k + 2) y[k + 1] - y[k] + (k + 2)/(2 k) y[k - 1] == 0, y[0] == 0, y[1] == 1}, y[k], k]
```

$$\left\{\left\{y[k] \to \left(1+i\right) 2^{-2-k} \left(1+k\right) \left(2 \left(1-i\right)^{-1+k} - \left(1+i\right)^{1+k} + i \left(1-i\right)^{k} k - \left(1+i\right)^{k} k\right)\right\}\right\}$$

```
? RSolve
```

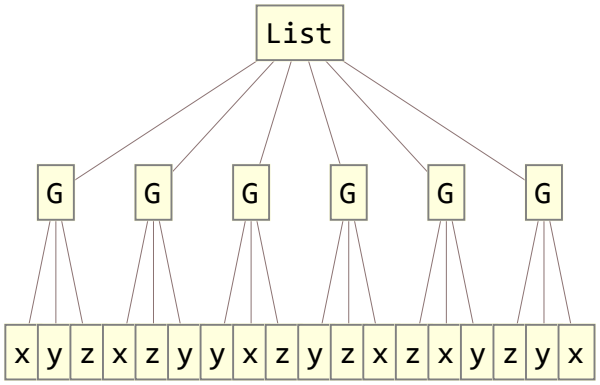
RSolve[*eqn*, *a*[*n*], *n*] solves a recurrence equation for *a*[*n*].
RSolve[{eqn_1, eqn_2, …}, {a_1[*n*], a_2[*n*], …}, *n*] solves a system of recurrence equations.
RSolve[*eqn*, *a*[n_1, n_2, …], {n_1, n_2, …}] solves a partial recurrence equation. ≫

Symmetrizer

```
G[x, y, z]
```

```
G[x, y, z]
```

```
Permutations@G[x, y, z] // TreeForm
```




```
Plus @@ Permutations@G[x, y, z]
(Length@G[x, y, z])!
```

$$\frac{1}{6}\left(G[x, y, z] + G[x, z, y] + G[y, x, z] + G[y, z, x] + G[z, x, y] + G[z, y, x]\right)$$

```
sym = Plus @@ Permutations@# &/Length@#!;
sym@G[x, y]
sym@G[x, y, z, w]
```

$$\frac{1}{2}\left(G[x, y] + G[y, x]\right)$$

$$\frac{1}{24}\left(G[w, x, y, z] + G[w, x, z, y] + G[w, y, x, z] + G[w, y, z, x] + G[w, z, x, y] + G[w, z, y, x] + G[x, w, y, z] + G[x, w, z, y] + G[x, y, w, z] + G[x, y, z, w] + G[x, z, w, y] + G[x, z, y, w] + G[y, w, x, z] + G[y, w, z, x] + G[y, x, w, z] + G[y, x, z, w] + G[y, z, w, x] + G[y, z, x, w] + G[z, w, x, y] + G[z, w, y, x] + G[z, x, w, y] + G[z, x, y, w] + G[z, y, w, x] + G[z, y, x, w]\right)$$

Deck of Cards

```
Join[{Ace}, Range[2, 10]]
```

```
{Ace, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

```
Hearts /@ {Ace} ~Join~ Range[2, 10] ~Join~ {Jacks, Queens, King}
```

```
{Hearts[Ace], Hearts[2], Hearts[3], Hearts[4], Hearts[5], Hearts[6], Hearts[7],
 Hearts[8], Hearts[9], Hearts[10], Hearts[Jacks], Hearts[Queens], Hearts[King]}
```

```
Hearts = Style[♡, {Red, Large}];
Diamonds = Style[♢, {Red, Large}];
Clubs = Style[♣, {Black, large}];
```

```
Style[♡, {RGBColor[1, 0, 0], Large}]
```

♡

```
Spades = Style[♠, large];
```

```
Diamonds = Style[♢, {Red, Large}];
```

```
Clubs = Style[♣, large];
```

```
Style[♣, large]
```

```
Style[♣, large]
```

```
Style[♣]
```

```
♣
```

```
Style[♢, {RGBColor[1, 0, 0], Large}]
```

♢

```
Style[♡, {RGBColor[1, 0, 0], Large}]
```

♡

```
Style[♡, {RGBColor[1, 0, 0], Large}]
```

♡

```
Style[♡, {RGBColor[1, 0, 0], Large}]
```

♡

```
Style[♡, {RGBColor[1, 0, 0], Large}]
```

♡

```
Spades = Style[♠, large];
```

```
Style[♠, large]
```

```
Style[♠, large]
```

```
♢♣♡♠
```

```
deck = # /@ {Ace} ~ Join ~ Range[2, 10] ~ Join ~ {Jacks, Queens, King} & /@
    {Hearts, Spades, Diamonds, Clubs} // Flatten
```

```
{♡[Ace], ♡[2], ♡[3], ♡[4], ♡[5], ♡[6], ♡[7], ♡[8], ♡[9], ♡[10],
 ♡[Jacks], ♡[Queens], ♡[King], Style[♠, large][Ace], Style[♠, large][2],
 Style[♠, large][3], Style[♠, large][4], Style[♠, large][5], Style[♠, large][6],
 Style[♠, large][7], Style[♠, large][8], Style[♠, large][9], Style[♠, large][10],
 Style[♠, large][Jacks], Style[♠, large][Queens], Style[♠, large][King],
 ♢[Ace], ♢[2], ♢[3], ♢[4], ♢[5], ♢[6], ♢[7], ♢[8], ♢[9], ♢[10],
 ♢[Jacks], ♢[Queens], ♢[King], Style[♣, large][Ace], Style[♣, large][2],
 Style[♣, large][3], Style[♣, large][4], Style[♣, large][5], Style[♣, large][6],
 Style[♣, large][7], Style[♣, large][8], Style[♣, large][9], Style[♣, large][10],
 Style[♣, large][Jacks], Style[♣, large][Queens], Style[♣, large][King]}
```

52

```
FactorInteger[52]
```

```
{{2, 2}, {13, 1}}
```

```
Shuffle := (shuffleddeck = RandomSample[deck];)
```

```
Shuffle
```

```
shuffleddeck
```

```
{Style[♣, large][7], Style[♠, large][Queens], ♢[Jacks], ♡[4], ♢[9], ♢[8],
 Style[♣, large][9], ♢[King], ♡[9], ♡[6], ♢[6], ♢[7], Style[♣, large][5],
 ♡[3], Style[♣, large][3], ♢[Queens], ♡[7], Style[♣, large][10], ♡[Jacks],
 Style[♠, large][2], Style[♣, large][8], ♡[10], ♢[4], Style[♣, large][Jacks],
 Style[♠, large][7], Style[♣, large][4], Style[♠, large][Jacks],
 Style[♣, large][Queens], Style[♣, large][Ace], ♢[5], Style[♠, large][6],
 ♢[2], ♢[3], Style[♠, large][8], Style[♠, large][9], Style[♠, large][4],
 Style[♠, large][3], Style[♠, large][5], Style[♠, large][King], ♡[8], ♡[Ace],
 Style[♣, large][King], ♡[Queens], ♡[5], ♡[King], Style[♠, large][Ace], ♢[Ace],
 Style[♣, large][6], Style[♣, large][2], ♡[2], Style[♠, large][10], ♢[10]}
```

```
take[n_] := Block[{temp = Take[shuffleddeck, n]}, shuffleddeck = Drop[shuffleddeck, n];
  temp]
```

```
take[2]
```

```
{Style[♣, large][7], Style[♠, large][Queens]}
```

```
shuffleddeck // Length
```

```
50
```

```
numbers = {Ace} ~ Join ~ Range[2, 10] ~ Join ~ {Jacks, Queens, King};
```

```
distribute = # /@ numbers &;
```

```
distribute[Hearts]
```

```
distribute2[x_] := x /@ numbers;
```

```
deck = # /@ numbers & /@ {Hearts, Spades, Diamonds, Clubs} // Flatten
```

```
{♡[Ace], ♡[2], ♡[3], ♡[4], ♡[5], ♡[6], ♡[7], ♡[8], ♡[9], ♡[10],
 ♡[Jacks], ♡[Queens], ♡[King], Style[♠, large][Ace], Style[♠, large][2],
 Style[♠, large][3], Style[♠, large][4], Style[♠, large][5], Style[♠, large][6],
 Style[♠, large][7], Style[♠, large][8], Style[♠, large][9], Style[♠, large][10],
 Style[♠, large][Jacks], Style[♠, large][Queens], Style[♠, large][King], ♢[Ace],
 ♢[2], ♢[3], ♢[4], ♢[5], ♢[6], ♢[7], ♢[8], ♢[9], ♢[10], ♢[Jacks],
 ♢[Queens], ♢[King], Style[♣, {■, large}][Ace], Style[♣, {■, large}][2],
 Style[♣, {■, large}][3], Style[♣, {■, large}][4], Style[♣, {■, large}][5],
 Style[♣, {■, large}][6], Style[♣, {■, large}][7], Style[♣, {■, large}][8],
 Style[♣, {■, large}][9], Style[♣, {■, large}][10], Style[♣, {■, large}][Jacks],
 Style[♣, {■, large}][Queens], Style[♣, {■, large}][King]}
```